with the fundamental characters of those elementary processes which are displayed by the excitable tissues of both animals and plants when their activities are aroused by definite stimulation; he thus returned to the topic which had attracted him during his student life at Edinburgh. The published researches of his later years on this subject have become models for all subsequent work, commanding admiration on account of the completeness of their design, and carrying conviction through the security of their foundation, which rests on the solid ground of mensurable records. The electromotive phenomena displayed by active tissues appeared to him to furnish the most trustworthy of such records, provided that appropriate instrumental methods were employed in their investigation; these he made every effort to utilise, and for this end he introduced into physiological method the recording capillary electrometer. His publications on the electromotive phenomena of the beating heart, on similar phenomena in the excitable leaves of the Dionæa plant, in voluntary muscle, in the electrical organs of fishes, &c., are examples of his activity in this field.

In the last year of his life he was still engaged upon this engrossing subject, and was planning and supervising investigations for the further elucidation of the electromotive phenomena present in muscle when thrown reflexly into activity. This piece of work, and others on various subjects of like nature, remain in an unfinished state, but, though fragmentary, they are so suggestive that it may be hoped they will be included in a future collection of his numerous scientific papers.

In conclusion, reference must be made to that commanding influence which true greatness exerts over other scientific workers, moulding their thought, stimulating their powers, and enriching their lives. The factors which contribute to the wielding of this influence defy precise definition, since, apart from acknowledged achievement in science, their essence is to be sought for in certain mental, moral, and physical qualities. In Burdon-Sanderson's case conspicuous traits stamped him as a leader of men, for his inspiring personality, his extraordinary charm of manner, and his wonderfully expressive face made a profound impression even on those whom he casually met. But his students, using the term in its largest sense, were conscious that the real impression made upon them was the work of more potent factors; his courtesy to even the humblest worker, the sympathetic interest with which he followed all experimental work, the breadth of his view, the profundity of his knowledge, ever placed ungrudgingly at the disposal of everyone who sought his help, the genuine character of his devotion to scientific truth, and the unwavering firmness with which he advocated the use of experimental methods. All these combined to attract and hold the younger physiologists and pathologists, and since they realised that it was a delight to him to mix with younger men the influence he exerted was profound. He often expressed his intense satisfaction at the vast change of which he had been a witness, a change which has in thirty years advanced British physiology and pathology into the first rank. The name of Burdon-Sanderson will be permanently associated with this extraordinary advance, for it is generally recognised that by work, example, and precept he has contributed in a very special degree towards the creation in this country of that vigorous band of workers who have given English medical science such a wide reputation.

F. G.

ANNIVERSARY MEETING OF THE ROYAL SOCIETY.

THE anniversary meeting of the Royal Society was held on Thursday, November 30, when the report of the council was presented, the president delivered his address, and the new council already announced (p. 33), for the year 1906, was elected. In the evening the anniversary dinner was held at the Hotel Metropole, Lord Rayleigh, the newly-elected president, being in the chair.

The report of the council refers, among other subjects, to the Royal Society Catalogue of Scientific Papers, the International Catalogue of Scientific Literature, the Meteorological Office, tropical diseases, Antarctic work, seismology, the International Geodetic Association, Indian Trigonometrical Survey, Astrographic Chart, and the National Physical Laboratory. A few matters recorded in the report have not been announced or described in these columns, and may therefore be mentioned here.

At the beginning of August, the Treasury expressed willingness to place on the estimates a sum not exceeding 200*l.* as an annual national contribution toward the expenses of the central bureau of the International Seismic Organisation should the adhesion of Great Britain to the international scheme be agreed to. On November 2, the council, having received a report on the subject from the Society's seismological committee, agreed to recommend that H.M. Government should join the organisation, and advised that Prof. Schuster be appointed the representative of this country to the organisation. The Treasury has agreed to the continuation by Great Britain of its adherence to the Geodetic Convention of 1895 for a further period of ten years from January 1, 1907, and to a payment during that period of an annual subscription of 6000 marks. Also, at the instance of the Royal Society, the Treasury has undertaken that one-half the cost of printing the British section of the International Astrographic Catalogue executed under Prof. Turner's direction, within a limit of 1000*l.*, shall be met from public funds.

The report of the council concludes with an expression of appreciation of Sir William Huggins's services to the Society during the five years in which he held the office of president, and the announcement that Lord Rayleigh had accepted nomination as his successor.

In his presidential address, Sir William Huggins dwelt upon the influence which discoveries of science have had upon the general life and thought of the world, especially during the past fifty years, and the place that science should take in general education. Some extracts from the address are subjoined:—

> The influence of science during the last fifty years has been in the direction of bringing out and developing the powers and freedom of the individual, under the stimulation of great ideas. To become all that we can become as individuals is our most glorious birthright, and only as we realise it do we become, at the same time, of great price to the community. From individual minds are born all great discoveries and revolutions of thought. New ideas may be in the air and more or less present in many minds, but it is always an individual who at the last takes the creative step and enriches mankind with the living germ-thought of a new era of opinion.
>
> All influences, therefore, and especially all laws and institutions which tend to lose the individual in the crowd, and bring down the exceptional to the level of the average, are contrary to the irresistible order of nature, and can lead only to disaster in the individual and in the State.
>
> I should not omit to mention the marvellous secondary effects of scientific discoveries upon the mental progress of

the civilised world which are being wrought by their practical applications to the cheapening of paper, and to improvements of the automatic printing-press, which, combined with the linking together of all parts of the earth by a network of telegraphic communications, put it in the power of even the poor of the realm to read daily the news of the world, and for a few shillings to provide themselves with a library of classical works. Of scarcely less educational influence upon the public mind are the new methods of photography and mechanical reproduction, by which pictures of current events and the portraits of those who are making contemporary history, and also copies of the world's masterpieces of painting and of sculpture, are widely disseminated with the cheap newspapers and magazines among the mass of the people.

Golden will be the days when, through a reform of our higher education, every man going up to the universities will have been from his earliest years under the stimulating power of a personal training in practical elementary science; all his natural powers being brought to a state of high efficiency, and his mind actively proving all things under the vivifying influence of freedom of opinion. Throughout life he will be on the best terms with nature, living a longer and a fuller life under her protecting care, and through the further disclosures of herself, rising successively to higher levels of being and of knowledge.

The importance to every man of a practical acquaintance with elementary science is obvious. Would it be thought possible that any nation could act so absurdly as to teach its children other languages, and leave them in complete ignorance of the tongue of the land in which they would have to pass their lives? Would it not then be incredible, if it had not become a too familiar fact, that the public schools have, until recently, excluded all teaching of the science of nature from their scheme of studies, though man's relation to nature is more intimate than to his fellow countryman? We live, move, and have our being in nature; we cannot emigrate from it, for we are part of it. Yet our higher education leaves men, who in other directions are well informed, much as deaf-mutes in the presence of nature. They do not hear her most imperative warnings, and can only get on haltingly in their everyday intercourse with the natural forces to which their lives are subjected, by means of the arbitrary signs of empirical custom. The recent introduction of some amount of science-teaching in our higher schools is quite inadequate, alike in kind and in degree. It can be only through a reform of the scheme of their examinations by the universities that we can hope to see science take the equal part with the humanities in general education to which she is entitled.

Two faculties of the mind which it is of the highest importance, especially in early youth, to enlarge and develop by exercise are wonder and imagination. Under the ordinary premature language-teaching of the grammar schools, even the wonder and imagination natural to young minds become so stunted in their growth as to remain more or less dormant throughout life. On the other hand, natural science brings them into full activity and greatly stimulates their development. Nature's fairy tales, as read through the microscope, the telescope, and the spectroscope, or spelt out to us from the blue by waves of ether, are among the most powerful of the exciting causes of wonder in its noblest form; when free from terror it becomes the minister of delight and of mental stimulation.

And surely the master-creations of poetry, music, sculpture, and painting, alike in mystery and grandeur cannot surpass the natural epics and scenes of the heavens above and of the earth beneath, in their power of firing the imagination, which, indeed, has taken its most daring and enduring flights under the earlier and simpler conditions of human life when men lived in closer contact with nature and in greater quiet, free from the deadening rush of modern society. Of supreme value is the exercise of the imagination, that lofty faculty of creating and weaving imagery in the mind, and of giving subjective reality to its own creations, which is the source of the initial impulses to human progress and development, of all inspiration in the arts, and of discovery in science.

Further, elementary science, taught practically with the aid of experiment during a boy's early years, cannot fail to develop the faculty of observation. However keen in vision, the eyes see little without training in observation by the subtle exercise of the mind behind them. From the humblest weed to the stars in their courses, all nature is a great object-lesson for the acquirement of the power of rapid and accurate noting of minute and quickly-changing aspects. Such an early training in the simpler methods of scientific observation confers upon a man for life the possession of an inexhaustible source of interest and delight, and no mean advantage in the keen competitions of the intellectual activities of the present day.

Training in the use of the eyes develops, at the same time, alertness of the intelligence, and suppleness of the mind in dealing with new problems, which, in after life, will be of great value in facing unforeseen difficulties of all kinds, which are constantly arising.

Science, practically taught, does more, for, under the constant control of his inferential conclusions by the unbending facts of direct experiment, the pupil gradually acquires the habit of reasoning correctly from the observations he makes. In particular, he learns the most precious lesson of great caution in forming his opinions, for he finds how often reasoning, which appeared to him to be flawless, was not really so, for it led him to wrong conclusions. Further, from the constant study of nature, the student comes so to look at things as almost unconsciously to discriminate between those which are essential and those which are only accidental, and so, gradually, to acquire the faculty of classing the facts of experience, and of putting them in their proper places in a consistent system or theory. Are there any other studies, it may be asked, by which, in the same time, a young mind could develop an equally enlarged capacity for correct reasoning and acquire so wide an outlook? Yet, notwithstanding the immense intrinsic value of its teaching, science is but one of the studies which are necessary for a wide and liberal education. Intellectual culture, or, in other words, the whole mind working at its best, requires, besides the training of all its powers harmoniously by the study of nature, an acquaintance with many other kinds of knowledge, especially of human history and the development of human thought, and of the human arts. Humanistic studies and experimental science are equally essential, and, indeed, complement each other. Either alone leaves the mind unequally developed, and its whole attitude one-sided, and so produces a narrow type of mind, which is incapable of taking a wide view even of its own side of thought, and has but little sympathy with any subject outside it.

Improved methods of teaching the classical languages, which would permit of the beginning of the study of them at a later age, would leave ample time for an early training in experimental science, which must soon come to be recognised as an essential part of all education.

In future, no grammar or higher school should be considered as properly provided for unless furnished with the necessary apparatus for teaching experimentally the fundamental principles of mechanics, physics, and biology. The pupils should have the use of a small astronomical telescope, and of microscopes for biological work. Such apparatus and instruments can now be purchased at a very small cost.

Clearly, it is only by such a widening of the general education common to all who go up to the universities, before specialisation is allowed, that the present "gap between scientific students careless of literary form, and classical students ignorant of scientific method" can be filled up, and the young men who will in the future take an active part in public affairs, as statesmen and leaders of thought, can be suitably prepared to introduce and encourage in the country that fuller knowledge and appreciation of science which are needed for the complete change of the national attitude on all science questions, which is absolutely necessary if we are to maintain our high position and fulfil our destiny as a great nation.

This address was followed by the award of the medals.

Copley Medal.

The Copley medal is awarded to Prof. Dmitri Ivanovitch Mendeléeff, For.Mem.R.S., for his contributions to chemical and physical science.

Prof. Mendeléeff, born at Tobolsk, in Siberia, in 1834,

stands high among the great philosophical chemists of the last century. As early as 1856 he published his own conclusion that paramagnetic elements have, in general, smaller molecular volumes than diamagnetic elements, and confirmed Avogadro's view that electropositive elements have larger molecular volumes than electronegative ones, both of them results specially interesting in connection with modern views of molecular structure. At that time he had already assimilated and utilised the views of Laurent, Gerhardt, and Williamson on molecular constitution, which made such slow progress in general. Since then, in the words of Dr. Thorpe (NATURE, June 27, 1889), "There is, in fact, no section of chemical science which he has not enriched by his contributions"—mineralogy, chemical geology, organic chemistry, the nature and industrial importance of petroleum, but, above all, physical chemistry and chemical philosophy.

Quoting again from Dr. Thorpe:—"His 'Principles of Chemistry,' published in 1889, and repeatedly reprinted, is a veritable treasure-house of ideas, from which investigators have constantly borrowed suggestions for new lines of research. This book is one of the classics of chemistry; its place in the history of science is as well assured as the ever-memorable work of Dalton." In the course of its preparation he developed the great generalisation known as the periodic law of the elements, with which his name will ever remain most closely associated, especially as a weapon for predicting new elements, and for which he has received the Davy medal of this society, as also have Newlands and Lothar Meyer for their independent advances in the same direction.

This law has changed the face of chemistry by imparting to the study of its numerous independent elements that close inter-connection which is a characteristic of advanced physical theories.

Royal Medals.

A Royal medal is awarded to Prof. John Henry Poynting, F.R.S., on account of his researches in physical science, especially in connection with the law of gravitation and the theories of electrodynamics and radiation.

Prof. Poynting is distinguished both in theoretical and experimental physics. His memoir, *Phil. Trans.*, 1884, "On the Transfer of Energy in the Electromagnetic Field," contains the fundamental proposition which is now universally known as Poynting's theorem. It was followed in *Phil. Trans.*, 1885, by a paper "On the Connection between Electric Current and the Electric and Magnetic Inductions in the Surrounding Field," which works out the current circuit on the supposition of motion of what are now called Faraday tubes. These papers served greatly to elucidate Maxwell's theory, and give a representation of the physical nature of the electric field which is now widely utilised. His long-continued experimental and theoretical researches on the constant of gravitation and on the mean density of the earth are reported in a paper in the *Phil. Trans.*, 1892, and in the Adams prize essay for 1893. Closely related to this subject is an experiment in search of a directive action of one quartz crystal on another, *Phil. Trans.*, 1899, which, though leading to a negative result, is a model of the application of refined methods to a physical research of great delicacy. His recent paper, *Phil. Trans.*, 1903, "On Radiation in the Solar System, its Effect on Temperature, and its Pressure on Small Bodies," is of great interest and significance in cosmical physics. He is the author of various theoretical papers on physicochemical subjects, such as change of state and osmotic pressure, which are conspicuous for originality of conception and clearness of exposition.

The other Royal medal is awarded to Prof. Charles Scott Sherrington, F.R.S., for his work on the central nervous system, especially in relation to reflex action.

Prof. Sherrington has published a series of important papers upon the structure and function of the brain and spinal cord. In the earlier of these he chiefly investigated the course of the several groups of nerve fibres by means of the degeneration method. Passing from the study of structure to that of function, he discovered that removal of the fore brain causes a widespread rigidity of certain muscles, which he called decerebrate rigidity. In the state of decerebrate rigidity, the ordinarily observed reflexes of the body become profoundly altered, and a study of the normal and abnormal reflexes led him to the observation that contraction of one muscle is commonly associated with inhibition of its antagonist. Upon this he formulated the law of the reciprocal action of antagonistic muscles, which is now accepted as of fundamental importance in the coordination of muscular movement. A further study of reflex actions led him to lay down certain general principles with regard to them. One principle deserves especial mention, namely, that hurtful stimuli applied to the skin produce a different form of reflex from that given by stimuli which are not hurtful. This has served as a basis for further investigation on the character of the nerve impulses conveyed by different nerve-endings, on the course taken by the impulses, and on their central connections.

In recent years a considerable amount of work has been done in mapping out the areas of the skin supplied by each of the cranial and spinal nerves. This work, essential both to physiology and to clinical medicine, received its chief impetus and most weighty contribution from the careful and detailed observations of Prof. Sherrington.

The researches of Prof. Sherrington and Dr. Grünbaum, on the localisation of the excitable areas in the cortex of the cerebral hemispheres in the higher apes, have resulted in placing the "motor area" in this animal entirely in front of the central sulcus. The result is now generally accepted as true also for the brain of man—a point of great importance in the surgery of the brain.

Prof. Sherrington's researches have dealt with a number of subjects cognate with that of the central nervous system. He has shed light on questions connected with the afferent nerves of skeletal muscle, the efferent nerves of the arrectores pilorum and of the cranial blood-vessels, the innervation of various viscera, the trophic centre of the fibres of the roots of the spinal nerves, the knee jerk, and with the physiology of vision.

Davy Medal.

The Davy medal is awarded to Prof. Albert Ladenburg, on account of his researches in organic chemistry, especially in connection with the synthesis of natural alkaloids.

Thirty years ago, when the validity of Kekulé's famous formula for benzene was the subject of much discussion, Ladenburg was the first to prove, by laborious research, the important proposition that the six hydrogen atoms in the hydrocarbon are similarly situated and discharge the same functions, and hence that three, and only three, *di*-substitution derivatives can exist.

He has also devoted many years to the study of the natural alkaloids. This pioneer work, attended by many experimental difficulties, was rewarded by success in the synthesis, for the first time in 1886, of an optically active compound identical with the alkaloid coniine existing in the hemlock plant. Since that time he has largely added to our knowledge of the chemistry of hyoscyamine, atropine, and other alkaloids of the mydriatic class.

Hughes Medal.

The Hughes medal is awarded to Prof. Augusto Righi, for his experimental researches in electrical science, including electric vibrations.

Prof. Righi has been for many years a prominent and active worker in the sciences of light, electricity, and magnetism.

Among the subjects which have engaged his attention are the Hall effect, and the change of electric conductivity of bismuth in a magnetic field. At an early period he carried out an elaborate investigation on the reflection of light at the surface of a magnetised body, repeating and extending Kerr's observations with more powerful apparatus; in particular, he showed how the amount of the rotation of the plane of polarisation depends upon the wave-length of the light.

A valuable series of papers related to phenomena produced by the ultra-violet rays, including the first discovery of the discharge of negative electricity from a freshly polished zinc surface under their influence. He has also investigated the potential in the neighbourhood of the kathode in a Crookes's tube, and made many experiments on the spark discharge in gases and the action of the Röntgen rays.

His work on electric radiation has been collected in a book, "L'Ottica delle oscillazioni elettriche," Bologna, 1897. He rendered fundamental service to exact experiment on this subject by simplifying the practical conditions of the problem; and he applied his improved apparatus to numerous investigations on the behaviour of electro-magnetic waves, of short and therefore manageable wave-length, under very varied conditions, on their absorption, polarisation, reflection and refraction, and on the behaviour of dielectrics in the field of radiation. This work entitles him to a high place among those who developed the lines of experimental investigation opened up by the great discoveries of Hertz.

More recently he has contributed substantially to the study of the phenomena of radio-activity and the related ionisations.

THE DEATH-KNELL OF THE ATOM.[1]

Old Time is a-flying; the atoms are dying;
Come, list to their parting oration:—
"We'll soon disappear to a heavenly sphere
On account of our disintegration.

"Our action's spontaneous in atoms uranious
Or radious, actinious or thorious:
But for others, the gleam of a heaven-sent beam
Must encourage their efforts laborious.

"For many a day we've been slipping away
While the savants still dozed in their slumbers;
Till at last came a man with gold-leaf and tin can
And detected our infinite numbers."

Thus the atoms in turn, we now clearly discern,
Fly to bits with the utmost facility;
They wend on their way, and in splitting, display
An absolute lack of stability.

'Tis clear they should halt on the grave of old Dalton
On their path to celestial spheres;
And a few thousand million—let's say a quadrillion—
Should bedew it with reverent tears.

There's nothing facetious in the way that Lucretius
Imagined the Chaos to quiver;
And electrons to blunder, together, asunder,
In building up atoms for ever!

W. R.

NOTES.

THE Hayden memorial gold medal has been awarded by the Academy of Natural Sciences of Philadelphia to Mr. C. D. Walcott, director of the U.S. Geological Survey, in recognition of the value of his individual contributions to geological science.

THE University of Basle, to which the late Prof. Dr. Georg W. A. Kahlbaum was attached for nearly twenty years, has received the sum of 100,000 francs from the mother of the deceased professor. Further, Prof. Kahlbaum's scientific library and physical instruments are also to be handed to the university.

FROM Berlin we learn, according to the *Chemiker-Zeitung*, that the German State grant for the support of scientific, technical, and similar undertakings is to be increased by 115,000 marks. The sum of 179,500 marks is to be spent upon increasing the accommodation for the permanent exhibition devoted to the interests of the working classes; 120,000 marks to be a first instalment for an investigation of sleeping sickness; 30,000 marks to be devoted to the development of the *Starkstrom*-laboratory of the Reichsanstalt; 43,850 marks to be contributed to the kite station on Lake Constance for experimental investigations of the higher air strata.

THE annual conference of the Pharmaceutical Society will be held in Birmingham in the week beginning July 23, 1906.

FOR the erection of a monument to Franz Reuleaux in the Charlottenburg Technical School, an appeal for subscriptions has been issued by the engineering department of the school.

MR. F. W. DYSON, F.R.S., chief assistant, Royal Observatory, Greenwich, has been appointed Astronomer Royal for Scotland, and also professor of practical astronomy, Edinburgh University, in succession to the late Dr. Copeland.

AN exhibition of electrical, optical, and other physical apparatus has been arranged by the Physical Society, and will be held on Friday evening, December 15, at the Royal College of Science, South Kensington. Admission will be by ticket only.

IT is reported, *Science* says, that the Mexican Astronomical Society has awarded the prize offered by the Bishop of Leon for some notable astronomical discovery to Prof. W. H. Pickering, of Harvard College Observatory, for the discovery of the tenth satellite of Saturn.

AN archæological museum, which will devote special attention to Indo-Chinese matters, has been established by the French Government at Pnompenh. The museum will be under the scientific control of the École française d'Extrême-Orient, the chief of the archæological department of which school will act as director of the new museum.

A DESCRIPTION is given in the *Engineer* of December 1 of some interesting machine-tools, formerly the property of James Nasmyth, lately placed on view in the southern galleries of the Victoria and Albert Museum. Although associated primarily with the invention of the steam-hammer, James Nasmyth did valuable work in the improvement of machine-tools.

AN extensive landslip has occurred in the Danish island of Möen, destroying part of the beautiful scenery along Lille Klint. From the beach, steep slopes of Boulder-clay, thickly wooded, rise about 250 feet. The right bank of the valley from Liselund Chateau, and the coast-cliff for some 400 yards to the south of it, in all some fifteen or twenty acres of woodland, are described as having sunk bodily. The sea had been encroaching, but underground water is regarded as the cause.

A *Times* correspondent reports that a local Greek newspaper publishes details of the earthquake of November 8, which caused great damage to the various monasteries on Mount Athos. The shocks, which were extremely violent, occurred in the night. None of the monasteries escaped without serious injury. The shocks were not confined to the colony of monks. At Caryes the post-office, the police station, and other public buildings have been ruined, and at Cassandra, Jerissos, Gomate, and other villages within the districts affected the churches and many houses have been destroyed.

IN the course of a lecture delivered at the Armstrong College, Newcastle-on-Tyne, on December 2, the Hon. C. A. Parsons, F.R.S., dealt with the application of turbines to Atlantic passenger steamers, and described the

[1] Sung at the Chemical Laboratory dinner at University College, November 17.